

INVESTIGATION ON PHYSICAL PROPERTIES OF JUTE

COTTON (JUTTON) BLENDED FABRIC

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ABSTRACT

As jute is eco-friendly along with bio-degradable and recyclable, it has a huge opportunity for the sustainable growth of the textile industry of Bangladesh in upcoming years. During this research, a plain woven fabric has been prepared from the blends of jute fibers with cotton fiber and their physical and mechanical properties have been studied. It is observed that the blended fiber fabrics show improved properties which have a serious potential to be used as a sustainable fashion fabric around the world.

KEYWORDS: Jute, Jute-Cotton blend, Jutton woven Fabric & Physical Properties

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INTRODUCTION

Jute is a prolonged, golden shiny natural best fiber with numerous environmental advantages containing about 60% cellulosic fibrils and 40% non-fibrous ground constituents like Lignin, the micelle lose which are making them relatively coarser and lower extensible. Jute is one of the cheapest vegetable fiber has many inherent advantages like luster, high tensile strength, moderate heat, and fire resistance, and long staple lengths. Since jute is a biodegradable along with recyclable and eco-friendly fiber, it has many amenities over other natural and synthetic fibers which protect the environment and maintains the ecological balance. Jute fiber conventionally is not used for producing wearable textile products as it has some shortcoming in regards to feeling, stiffness, drape, coarseness, wash ability and abrasion [1]

A fabric produced from the blended yarn might have better characteristics than what could be obtained in a fabric produced from a single fiber. [2] Blending of a fiber is usually done to achieve or improve certain characteristics of the yarn or it is processing performances which ensures the diverse use of this modified fiber in the field of various textiles. Blending jute with cotton fiber may be an acceptable way of jute diversification by which value added products can be produced. Hence the techniques of blending and softening could as utilize to upgrade the quality of jute and thus form a new class of jute-based fabrics having an expanding market within and outside the country [3]. The worldwide awareness on the environment is the reason for the opportunities of Jute, due to environmental friendly characteristics. Jute, a natural fiber that can be used in many different areas,

supplementing or replacing synthetics, has been receiving increasing attention from the industry [4].

Any successful attempt to blend jute fiber with cotton would be a breakthrough in the field of textile [5]. The use of fabrics made from Jute-Cotton blended yarns would surely strengthen our economy by cutting a part of the cost incurred for importing cotton and enhancing the value addition due to locally produced cheaper jute as a raw material [6]

In the present work, a jute, cotton (jutton) blended plain woven fabric has been collected for the study. The concentration has been imparted upon looking into the physical properties of the jute–cotton blended plain woven fabric. Tensile Strength, Moisture content, Air Permeability, Crease recovery, Stiffness, Pilling, Abrasion Resistance, and Thickness of the fabric have been studied.

MATERIALS AND METHODS

Materials

In order to fulfill this project work, Jute, Cotton blended (67% JUTE +33% COTTON) plain weave fabric was collected from Sonali Aansh Industries Limited. Plain woven fabrics were prepared on the Rapier looms (The weaving was done as per one up, one down principle) and properly bleached and finished. Fabric width was 150 cm and having GSM of 411 gm/m².



Figure 1: Jute- Cotton Blended Bleached Fabric

Table 1: Fabric Construction

Name & Color	Type	Content	Epixppi	Width	Loom Type
JC-01 Bleached	Jute + Cotton	67% Jute 33% Cotton	22(2 ply) X 18	150 CM	Rapier

Methods

The mentioned fabric was tested and the result was analyzed in the Textile Testing & the Quality Control Laboratory and accredited laboratory of the Bangladesh University of Textiles henceforth the data has been furnished in the tables below.

Physical Properties testing of the chosen fabrics:

Tensile Strength, Moisture content, Air Permeability, Thickness, Crease recovery, Stiffness, Pilling, Abrasion Resistance testing was done for the selected fabrics.

Tensile Strength Test

The Tensile strength of the fabric sample was determined on James Heal Tensile Strength Tester with a Pull to cell speed of 50mm. /min and Load cell of 5000N by using Grab method. (ISO13934-2:2014)

Moisture Content

The moisture content of the fabric was measured in ANAMOIST Textile Moisture Meter which is based on the

electrical conductivity of the material which always bears a fixed relation to the moisture.

Air Permeability

The air permeability of a textile fabric is determined by the rate of air flow through a material under a differential pressure between the two fabric surfaces [7]. Air permeability is an important factor in the performance of a textile material. FX 3300 Lab Air IV Air Permeability Tester was used to determine the Air permeability of the fabric by using ASTM D737 method.

Thickness

AMES thickness gauge machine was used to evaluate the nominal thickness of the fabric sample and expressed in mm where ASTM D1777 test method was applied.

Stiffness

Stiffness properties such as bending length of the fabric were determined according to internationally recognized test standard ASTM –D1388 method by using Shirley Stiffness Tester where the cantilever bending principle has been employed.

Crease Recovery

The magnitude of the crease recovery angle is an indication of the ability of a fabric to recover from accidental creasing. Crease recovery was tested by the Shirley Crease Recovery Tester according to ISO 2313:1972 method.

Pilling & Abrasion Resistance

Martindale abrasion testing machine was used to discern both pilling and abrasion resistance of the fabric where ISO 12945-2 method was used for determining abrasion resistance and ISO 12947-2 method was employed for determining pilling

Table 2: Category of Pilling and Abrasion Test

Textile Type	Abradent Type	Loading Weight	Assessment Stage	Number of Rubs
Woven fabrics (except upholstery fabrics)	Woven fabric under test (face/face) or wool fabric	415±2	1	125
			2	500
			3	1000
			4	2000
			5	5000
			6	7000

Table 3: Test Intervals for Abrasion Testing

Test Series	Number of Rubs at Which Specimen Breakdown Occurs	Test Interval (Rubs)
1.	<5000	Every 1000
2.	>5000< 20000	Every 2000
3.	>20000<40000	Every 5000

RESULTS AND DISCUSSIONS

Tensile Strength Test

For designing apparel as well as for other uses, the knowledge about the tensile properties of woven fabrics is important. Strength and elongation are the most important performance properties of fabric governing the fabric performance in use. Tensile strength is the ability of a material to withstand a pulling (tensile) force. It is customarily measured in units of force per cross-sectional area.

The strength of a fabric depends not only on the strength of the constituent yarn but also on the yarn structure. In this fabric, Jute-cotton blended yarn was used in a warp direction and jute yarn was used in the weft direction.

The result obtained from the test (breaking force and breaking elongation) shown in Table 4 & 5.

Table 4: Breaking Strength of the Test Specimen

Direction	Warp		Weft	
Observation No.	Maximum Force(N)	Mean Maximum Force(N)	Maximum Force(N)	Mean Maximum Force(N)
1.	408		774	
2.	420		679	
3.	415	417	828	753
4.	431		786	
5.	410		697	

Table 5: Elongation at Rupture of the Test Specimen

Direction	Warp		Weft	
Observation No.	Elongation at Rupture (%)	Mean Elongation at Rupture (%)	Elongation at Rupture (%)	Mean Elongation at Rupture (%)
1.	21.07		5.26	
2.	21.36		4.95	
3.	21.22	21.3	5.01	5.06
4.	21.66		5.26	
5.	21.09		4.95	

It was found out that the breaking force of weft yarn was considerably higher than warp yarn. Moreover, the breaking force of yarns in both direction influences the extensibility (elongation at rupture) of yarns.

So garments made from jute, cotton blended fabric would provide a good performance as to breaking force and breaking elongation properties in contour with a cotton, woven fabric of the similar structure.

Moisture Content & Air Permeability

The ratio of water in a material to the total weight of material is known as moisture content. Some of the properties of a textile fiber are closely related to its behavior in various atmospheric conditions. Many physical properties of the fiber are affected by the amount of water absorbed – dimension, tensile strength, elastic recovery, electrical resistance, rigidity and so on.

Woven fabrics are produced by interlacing warp and weft yarns. There are voids between weft and warp yarns in the fabric. The void volume in woven textile fabric causes air permeability. Air permeability is used to provide an indication of the breathability of a fabric.

Table 6: Moisture Content & Air Permeability of the Test Specimen

Observation No.	Moisture Content	Avg. Moisture Content	Air Permeability (cm ³ /cm ² /S)	Avg. Air Permeability (cm ³ /cm ² /S)
1.	4.9		3.12	
2.	5		3.35	
3.	4.9	4.94	3.29	3.26
4.	4.9		3.21	
5.	5		3.33	

The test swatch of Jutton fabric showed moisture content of 4.94% in average, which is not superior in comparison with 8.5% moisture content of cotton woven fabric of similar construction and design. But it is moderate. So we can expect that this type of jute cotton blended fabric will show sufficient breathability and comfortability in practice.

Thickness

Fabric thickness is defined as the perpendicular distance through the fabric, which determines the dimension between the upper and lower side of the fabric [8]. Thickness is controlled handle, creasing, thermal resistance, heaviness or stiffness in use and many other properties of fabric.

Table 7: Thickness of the Test Specimen

Observation No.	Thickness (mm)	Avg. Thickness (mm)
1.	1.12	
2.	1.13	
3.	1.12	1.12
4.	1.12	
5.	1.12	

As jute fibers are naturally of coarser kind, the test specimen made from the high percentage of jute exhibit an average thickness of 1.12mm which is very good. Apparel made from jutton fabric is going to be an excellent alternative of wool or other synthetic fabric used for winter garment as the fabric also has the capability of retaining body temperature which is a major attribute of winter cloth.

Crease Recovery

Recovery from creasing is an important attribute of a fabric. Creases in textile fabrics diminish at varying rates on the removal of the creasing forces. If the crease recovery is higher, it will give the fabric more dimensional stability during converting a fabric into apparel.

Table 8: Crease Recovery of the Test Specimen

Observation No.	Warp		Weft	
	Recovery Angle	Average	Recovery Angle	Average
1.	60°	63.2°	59°	57.6°
2.	65°		57°	
3.	65°		57°	
4.	63°		58°	
5.	63°		57°	

The test jutton fabric swatch showed good crease recovery with an angle of 63.2° in a warp direction and 57.6° in the weft direction. So, we can come to a point that apparel made from Jutton fabric would exhibit a better dimensional

stability.

Stiffness

The main limitation of jute is its stiffness and the fiber is coarse compare to flax or cotton. It is difficult to make finer uniform yarns. Blending with cotton and proper finishing aided to mitigate this issue of our fabric.

Table 9: Stiffness of the Test Specimen

Observation No.	Warp		Weft	
	Bending Length(cm)	Average, Bending Length	Bending Length (cm)	Average Bending Length
1.	3.2	3.4	3.1	3.04
2.	3.4		3	
3.	3.5		3.1	
4.	3.4		3	
5.	3.5		3	

The test specimen of Jutton fabric showed moderate stiffness. In practical it showed an average bending length of 3.4 cm in a warp direction and 3.04 cm in the weft direction. So this fabric is good enough to prepare outerwear.

Pilling Performance and Abrasion Resistance

Abrasion resistance and pilling performance are two of the most important mechanical characteristics of fabrics. Pilling is a formation of little balls of fibers (pills) on the surface of a fabric which is caused by abrasion in wear. Abrasion resistance” is often stated in terms of the number of cycles on a specified machine, using a specified technique to produce a specified degree or amount of abrasion. In this study, the abrasion resistance and pilling performance of Jute- cotton blended woven fabric were evaluated. The pilling performance of the fabric after rubbing is shown in the table-

Table 10: Assessment of Pilling Performance after Numerous Cycle of Rub

S/N	Assessment Stage	Number of Rubs	Grade
1	1	125	GRADE-5
2	2	500	GRADE -5
3	3	1000	GRADE -5
4	4	2000	GRADE-4
5	5	5000	GRADE-4

Test results for the pilling tendency of our test fabric is explained visually in the photographs below-



Figure 2: Before Test



Figure 3: After Test

Pill formations may not be observed clearly at 125, 500 and 1000 cycles. For this reason, 2000 - 5000 cycles were

chosen for the pilling test. Subsequently, every certain number of rubs the samples were examined and given a rating of Grade 1-5 the number of pills counted. The fabric was rated as GRADE-4 following 5000 cycles which means the fabric shows excellent pilling performance.

Abrasion Resistance

Test results for abrasion resistance of the specimen is illustrated visually in the figure given below-



Figure 4: Lacerated Sample after Abrasion Test

The abrasion test was continued until the preselected number of rubs is reached and the specimen was lacerated after 26000 cycles.

Apparel made from jute, cotton blended fabric will exhibit magnificent abrasion resistance and pilling performance.

CONCLUSIONS

In this research, we have studied on jute-cotton blended fabric which asserted excellent physical performance like high tensile strength, pilling performance and abrasion resistance with comfort over low price. After perusal of this fabric, we can deduce to a point that as an eco-friendly material Jute Cotton blended fabric has serious potential to perform as the textile substitute. This can also be a great initiative to protect the environment and sustainable growth of apparel industry.

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